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ABSTRACT

This planning guide is one of three that addresses the concerns of postsecondary college administrators and planners regarding the planning and implementation of technician training programs in high technology areas. It specifically focuses on a 30-step planning process that is generalizable to various high technology areas. (The other two documents address computer-aided design and robotics programs.) Contents are divided into three parts. The first part reviews the problem, objectives, methods, and outcomes of the project. Preplanning for long-range activities is discussed in part 2. Fourteen questions are answered that have been identified as being important to answer before identifying members to serve on an advisory council or attempting to implement high technology training programs. Part 3 presents the 30 steps of a 2-year planning process for high technology training programs. The 30 steps are grouped into 5 major phases of activity including long-range planning, program planning, development, implementation, and evaluation and refinement. Each step or activity is discussed in detail, along with lists of "do's and don'ts." Appendixes are a compilation of site visits by project staff and a publication on the Develop a Curriculum (DACUM) process. (YLB)

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Research & Development Series No. 232

PREPARING FOR HIGH TECHNOLOGY:
30 STEPS TO IMPLEMENTATION

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FOREWORD

Planning for high-technology training programs involves some unique problems for postsecondary administrators and planners. High-technology programs carry with them the uncertainty of labor market demands, the scarcity of qualified instructional staff, and the lack of curricula that are based on industries' needs for entry-level skills. Compounding this situation is the rapidly changing nature of high technology itself, particularly in its early stages of impact on user and consumer markets. New methods and techniques for planning, developing, and implementing these programs are necessary to enable postsecondary institutions to provide for effective instruction and learning.

To assist postsecondary program administrators in the planning and implementation of high-technology training programs, the National Center for Research in Vocational Education enlisted the assistance of Dr. Bill J. Rose, Dean of Career Education at Oakland Community College, Auburn Heights, Michigan to prepare this compilation of planning procedures for high-technology programs in postsecondary colleges. The National Center is indebted to Dr. Rose for his insightful presentation of a thirty-step planning process and his identification of critical features that determine successful outcomes. Dr. Rose's work is supplemented by the contributions of Dr. Bertha Landrum, District Director of Occupational Education in the Maricopa Community College District, Arizona.

Dr. Landrum's involvement in the Maricopa County High-Technology Industries' Advisory Council has provided a rich base of experience in long-range planning, which she has shared in this document. The National Center is grateful for her interest and assistance in this project.

The National Center would also like to acknowledge the assistance of James Long, National Center for Research in Vocational Education; Joseph Keller, Dean for Instructional Advancement, Brevard Community College, Cocoa, Florida; and John Light, President, Hocking Technical College, Nelsonville, Ohio for their review of the draft and helpful suggestions for revision.

The project was conducted by William Ashley and Robert Abram. Dr. Ashley's background is in industrial technology, instruction, and training development, and he has a Ph.D. in vocational education research from The Ohio State University. Mr. Abram was previously employed by Battelle Laboratories, where he conducted research projects in human factors and vocational education. He holds a master's degree in psychology from The Ohio State University. Since joining the National Center staff in 1975, both researchers have conducted a number of studies of skill transfer, education and training, and high-technology changes in postsecondary programs.

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Robert E. Taylor
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in Vocational Education

EXECUTIVE SUMMARY

This document is one of three that address the concerns of postsecondary planners that are related to technician training needs in high-technology areas.

The development of high-technology training programs has become a major concern for postsecondary colleges across the country. In addition to the general scarcity of labor market and economic impact data for high-technology occupations, considerable uncertainty exists among postsecondary administrators about the planning dynamics for new high-technology programs. Curricular information is limited and there are usually few experts or experienced workers knowledgeable about the new technologies. Hence, the primary objective of this project was to collect and compile program planning and implementation information that could help reduce the planning and development burden of postsecondary colleges. Specifically, this document focuses on a thirty-step planning process that is generalizable to various high-technology areas. The other two documents prepared by the project staff present sets of guidelines and specifications for assisting postsecondary planners in the development of high-technology programs in computer-aided design and in robotics.

Part 1 of this document is the report of the project and includes discussions of the problem, objectives, methods, and outcomes related to planning and implementing a new high-technology training program. The methods used to prepare this planning document included a review of technical reports, published material on institutional planning, and other sources on specific aspects of planning, such as advisory groups, program evaluation, and curriculum development. Site visits were conducted to several postsecondary colleges to discuss current planning strategies with presidents and deans of those institutions. Project staff also attended several high-technology conferences and meetings and contacted staff of two professional organizations for resource material. From these project activities, project staff prepared a preliminary planning outline, which was subsequently developed and refined by project consultants.

The discussion of project outcomes presents the rationale that guided the identification and collection of information and the references for the thirty-step planning process. Considerations related to planning steps, key actors and their roles, and critical planning features are offered as the basis for the rationale. Project outcomes, including the planning process and supplementary resources, are listed. The thirty-step planning process is grouped into five major phases. Each phase and the steps grouped within it are shown in the listing.

Part 2 discusses preplanning for long-range planning activities. Fourteen questions have been identified which are important to answer before identifying members to serve on an advisory council or attempting to implement high-technology training programs:

- Is a long-term relationship of five, ten, or more years anticipated for the life of the council?
- What role is envisioned for the council?

- What definition of a "high-technology" firm should be used?
- What firms, organizations, or persons will be on the advisory council?
- What level of administration or supervision should be represented by each firm or organization on the council?
- Who can assist the college(s) in putting the council together?
- Who will chair the advisory or planning council?
- What support will the college(s) provide to the council?
- What information and resource support will the college(s) need to carry out the planning functions?
- What benefits will accrue to the firms for their participation?
- What commitments to long-range, high-technology programs can the college(s) make in dollars, staffing, facilities, and equipment purchases?
- What priority will the occupational programs that support high technology enjoy in relation to other programs and services of the college(s)?
- How can council members become familiar with the college(s)' operational procedures and pace?
- How can the college(s) maintain long-range commitment from the council?

The major focus of this report is the thirty-step procedure for planning and implementing successful high-technology programs in postsecondary colleges. The procedures are illustrated in a flow chart that shows sequence and relationship among planning steps. Also included are lists of "do's" and "don'ts" for each step and for the total planning process. The thirty steps are grouped into five major phases of activity including long-range planning, program planning, development, implementation, and evaluation and refinement.

Appendix A is a compilation of site visits conducted by project staff, including visits to postsecondary institutions, robot manufacturers and users, and computer-aided design/computer-aided manufacturing (CAD/CAM) users.

Appendix B contains a National Center publication on the **D**evelop **A** Curricul**UM** (DACUM) process, including its purpose, history, and major procedures. This procedure can be used to conduct task analyses for developing training programs for new high-technology occupations.

PART 1

REPORT OF THE PROJECT

Introduction

This planning guide is one of three that address the concerns of postsecondary college administrators and planners regarding the planning and implementation of technician training programs in high-technology areas. High technology, as used in this document, refers to those complex systems that use computers to (1) receive, process, display, and transmit information; and (2) control processes, machines, and devices.

This planning guide is intended primarily for use by presidents, deans, and faculty of postsecondary colleges, but its contents have relevance for business and industry leaders as well. The planning process for high-technology training programs requires that leaders in education and industry collaborate closely to achieve outcomes that will benefit both. The importance of this collaboration is emphasized in the first step of the planning process, which is the formation of a high-technology advisory council of both education and industry leaders. Many of the remaining twenty-nine planning steps reflect a similar education-industry team approach. Thus, if postsecondary colleges wish to succeed in developing high-technology training programs, they must strive to gain the support and confidence of local industry. This document was prepared to assist both groups in achieving these outcomes.

The contents of this document are divided into three parts. The first part reviews the problem, objectives, methods, and outcomes of the project. The second part discusses preplanning activities, and the third part presents the thirty major steps of a two-year planning process for high-technology training programs. Lists of "do's" and "don'ts" are included with each planning step in part 3 to increase the potential for a successful planning effort. Two appendices include information on the sites visited and on additional resources for planning programs.

The Problem

Previous research conducted by The National Center (Faddis, Abram, Ashley 1982) found that postsecondary institutions expend considerable time and energy obtaining information about emerging high technologies. Part of this information gathering is directed toward understanding these technologies and their impact on industry and the labor market. Another part is focused on the many considerations and details affecting the planning and implementation of high-technology training programs. In particular, postsecondary program planners are concerned with the following questions:

- Where can assistance be obtained for understanding the nature and impact of new high technology?

- What unique problems will be confronted in planning a high-technology training program?

- What type of institutional support structure is needed to insure that the new program will fit into existing staff configurations and program offerings?

- When and how should preliminary planning processes involve business and industry leaders and postsecondary administration and faculty?

Various answers to these questions have been discussed at high-technology conferences, in the published literature, and in personal communications between postsecondary administrators and educators.

Efforts to obtain definitive answers to these questions are particularly perplexing during the early stages of high-technology impact, because there are few experts knowledgeable about the training and education implications of such technologies. Furthermore, during the early stages, most (if not all) postsecondary colleges struggle with similar program development problems, and interinstitutional assistance is unlikely in terms of sharing planning strategies or identifying curriculum materials, instructional expertise, methods for acquiring equipment, and so forth.

These problems point to the need for information and resource material in a form that postsecondary planners and business and industry leaders will find practical and immediately useful for early and incisive responses to high-technology training needs. Such planning material should reduce the potential of costly mistakes "up front," and should be adaptable to the rapid changes in today's technologies.

Objectives and Methods of the Project

The overarching objective of the project was to provide guidance and assistance to postsecondary education leaders and faculty involved in developing and implementing training programs in advanced technology areas. A major focus of the work was to describe a set of generalizable procedures for program planning and development that could be applied to any high-technology area. To carry out this activity (and other project tasks), project staff drew on the advice and assistance of technical consultants from both education and private industry.

Project staff conducted site visits to companies that use or manufacture robots or computer-aided design/computer-aided manufacturing (CAD/CAM) systems and to postsecondary institutions that have developed training programs for robotics or CAD/CAM technology.

Planning strategies were of particular concern during visits to the postsecondary colleges, where reviews and discussions of short-term and long-term planning procedures for high-technology training programs were conducted with deans and other planning personnel. Attempts were made to identify, by title or position, the key individuals within the college faculty and industrial community who were critical to promoting fiscal support and influencing the political climate needed to initiate and carry out a successful plan. Other areas of concern during these discussions focused on decision-making responsibilities, committee compositions and schedules, important linkages with community leaders and potential employers, and considerations regarding facility modification or new facility construction.

Project staff also attended several high-technology conferences and meetings at which representatives from high-technology user groups and postsecondary colleges discussed issues related to what the colleges should do to prepare workers for jobs in high-technology industries.

Project staff also contacted the National Computer Graphics Association and Robotics International of the Society for Manufacturing Engineers. These organizations had recently completed or were in the process of completing surveys of educational trends in their respective technologies and also had access to other useful information, such as lists of vendors, prominent high-technology users, and research sites.

Finally, various types of information, including conference proceedings, institutional planning documents, vendor training materials, and other documents pertaining to program planning and development, were reviewed to determine what resources were available to help prepare the planning procedures for this document.

On the basis of the information gleaned from the activities described above, a preliminary planning document was prepared to serve as a working model for more complete and detailed development by a project consultant. The model consisted of a flow chart of steps or procedures for planning high-technology training programs, from the identification of the program area to student enrollment and program evaluation. A descriptive narrative of one of the planning steps was prepared to give the consulting writer a sense of the format, level of detail, and scope to be represented throughout the planning document. A sample list of "do's" and "don'ts" was also prepared to illustrate important considerations and caveats that should accompany each procedure or step. This working program development model was then sent to the consultant, Dr. Bill J. Rose, for further development and refinement.

Dr. Rose has been instrumental in the planning and development of high-technology training programs for robotics and CAD/CAM, including the design and construction of a High Technology Center at Oakland Community College, Auburn Heights, Michigan. The Center is scheduled for occupancy in September 1983. Dr. Rose's recent involvement in these activities as well as his background and training in higher education and administrative science were the major criteria for selecting him as the project's principal consultant in the area of program planning and development. In addition to his administrative and planning experiences at Oakland Community College, Dr. Rose's resources for preparing this document included a number of publications on institutional planning, as well as other documents provided by the National Center.*

The draft prepared by Dr. Rose was sent for review and revision to Dr. Bertha Landrum, District Director of Occupational Education in the Maricopa Community College District, Arizona. In addition to her responsibilities as district director, Dr. Landrum has been a leader in the development and ongoing activities of the High-Technology Advisory Council in Phoenix, Arizona. She made significant contributions to the development of this planning document.

Outcomes

Throughout the duration of the project, project staff sought to compile information and references that would be useful to postsecondary program planners and developers. In preparing the planning procedures, a number of considerations were used as a basis for identifying and collecting information that would be applicable across a broad range of new high-technology programs. One of these considerations was the critical steps (including their sequence and interrelationships) that comprise a successful planning strategy. Another consideration focused on the key actors and their roles and responsibilities in implementing a planning strategy. The third consideration, which was closely related to the first two, concerned identifying the pitfalls

*These publications and documents are compiled in the Bibliography.

and caveats of which key actors should be aware in negotiating each step in the planning process.

In addition to guiding project development activities and the selection and inclusion of material in this document, these considerations also influenced the formulation of project outcomes. The major outcome—a thirty-step planning process—was organized as five major phases. The five planning phases and supplementary resources are as follows:

Outcome

Phase I. Long-Range Planning (Steps 1 and 2)

Phase II. Program Planning (Steps 3 - 8)

Phase III. Program Development (Steps 9 - 19)

Phase IV. Program Implementation (Steps 20 - 27)

Phase V. Program Evaluation and Refinement (Steps 28 - 30)

Resources

Site Visits (Appendix A)
DACUM Process (Appendix B)
Bibliography

The next part reviews the preplanning and long-range planning guidelines developed by the project staff and consultants.

PART 2

PROGRAM PLANNING GUIDELINES

Introduction

Technological changes that have been occurring gradually since the 1930s and 1940s seem suddenly to have surged into prominence in the 1980s. These changes have focused primarily in the area of developments in electronics technology, which, through miniaturization, computerization, and automation, has stimulated the development of a multitude of other innovations.

These technological innovations have combined with such products and processes as lasers, fiber optics, and semiconductor chips to create fascinating new consumer and industrial products and processes. When trying to articulate a complex phenomenon in our midst, there is a tendency to invent a "catchy" label for it. Thus, the term "high technology" was invented—a term that often says less or more than is intended, but always conveys an aura of glamour, excitement, and space-age adventure.

Glamorous or not, the hoped-for promise of "high technology" is that the computerized and automated products and processes will enable us to do more, do it better, and do it faster, thereby making our offices, transportation systems, manufacturing plants, and communications systems more productive. In our personal lives we also spend billions of dollars annually for personal microcomputers, not only to make a better greeting card mailing list or play a challenging video game, but also to speed up income tax preparation and improve our data bases for insurance claims and so forth. The microprocessor (small computer) now also allows monitoring and regulation of major portions of our automobiles, and control of industrial robots, utility systems, and other manufacturing equipment.

It is possible to visit a large computer manufacturing or semiconductor processing firm and note the contrast of the very productive computer-aided design (CAD) department rapidly producing elements of a new product design with strokes of a light pen, while assembly personnel sit at "high-tech" work stations, hand-soldering tiny wires viewed through a magnifying lens or microscope. In this juxtaposition of intermediate technology and high technology, it becomes apparent that it does not always take "high-tech" processes to turn out a high-technology product. The important point to keep in mind is that the firm is undoubtedly working on a way to speed up and automate that hand-soldering process so that more of the designs from the CAD department can be transferred to automated manufacturing equipment.

Regardless of the level of the technological process used in manufacture, word processing equipment is replacing typewriters, CAD stations are supplementing drafting tables, robots are welding automobile frames, and manufacturing tools are being controlled by computerized numerical processing. These relatively recent innovations are forcing changes in management, whether in the office, the plant, or in long-distance operations of the phone company.

The challenge to colleges is to produce workers who can manage, operate, manufacture, test, design, program, install, maintain, and repair these products and processes. These nine activities are indicative of the scope of problems that educators face in developing programs to serve the needs of high-technology industry. Sorting out the nature of the skills needed in different industries requires outside assistance.

The good news is that many colleges already have many programs essential to support the training needs of high-technology industry. Such programs include the current array of electronics, drafting, automotive, machining, management, data processing, and manufacturing process programs. Community colleges also offer such support courses as technical writing, mathematics, physics, chemistry, biology, and business. Other available college resources may include (1) space that can be rearranged or remodeled; (2) permanent faculty who, although they may be a little out of date regarding new technology, are familiar with the resources of the college and know how to develop curriculum; and (3) existing curriculum/program advisory committees familiar with the college staff, equipment, and facilities.

If a college does not have a long-range planning process in place, the college should undertake that process before embarking on immediate development of new high-technology training programs. Several important outcomes can be realized from initiating such a process. They are as follows:

- Involvement of a large portion of the college faculty in planning the future directions of the institution and in coming to a consensus on the strengths, weaknesses, and goals of the college
- Identifying resources available or obtainable for projects or programs
- Establishing the broad priorities of the college
- Devising strategies for activities to achieve the goals of the college
- Engendering support and committee work to get projects and programs in place

A consensus of the direction that the college should take should help the college administrators and faculty as they work with representatives of industry, government, and other colleges. Arriving at a consensus should also assist the college in avoiding internal dissension and disagreement over which programs should receive attention and why. The planning process should assure the board of trustees that careful thought has been given to the use of funds, and that a broad spectrum of the college recognizes the related needs and will support future directions.

Long-Range Planning

There are several ways to approach long-range planning. A "strategic planning process" is suggested, in which assumptions about future conditions affecting the programming of the college are formulated. The assumptions should be based on observable financial, population, economic, and technological trends. Internal barriers and facilitating events should also be tracked and incorporated in the planning formula.

A strategic planning process will engage the planning group in identifying the most critical issues the college must address in the development of occupational programs and planning

goals for a five-year period. Further it will assist those responsible for implementing the plan to focus on the activities and decisions of highest priority. An excellent source for planning literature is documentation produced through corporate strategic planning activities. This source can help a college learn the terminology and understand the thinking of corporations.

If there are several colleges offering technical education in an area, it may be advantageous for them to form a consortium or other organization for the purpose of addressing short- and long-range problems of mutual concern. This cooperative venture should enable them to share the costs of programs, including costs of staff, facilities, and equipment. The reduction of costly duplication and a cooperative rather than a competitive college approach to relationships with industry should gain the goodwill and support of companies that otherwise might be reluctant to use the time of several executives on multiple advisory groups.

In order to target program improvement and development efforts most effectively, linkages with other agencies (e.g., the labor market information services, local employment service, and the local economic development agency) are necessary. These agencies can be helpful in obtaining essential human resource data for establishing program development priorities.

It is also critical to establish a long-range planning committee (such as the high-technology advisory councils discussed here and in part 3), before initiating any activity to establish high-technology training programs. Such advisory councils are essential to getting these efforts off the ground. They are particularly important for colleges in urban areas, where there are high concentrations of manufacturing firms producing a broad array of products new to the marketplace. The sudden appearance of such firms and their products often creates uncertainty about the directions in which technology applications (and related occupations) are going. Visiting such firms and discussing their needs and plans with company representatives often only adds to the uncertainty. Thus, a major role of an advisory council is to provide an industry-wide perspective on current and future technological (and related occupational) directions.

High-Technology Advisory Council

A number of crucial questions must be answered by college administrators before establishing high-technology advisory councils or attempting to implement high-technology training programs. These questions are essential to identify appropriate council members and to define their responsibilities, in order to establish an effective council.

1. **Is a long-term relationship of five, ten, or more years anticipated for the life of the council?** If it appears that technological change in the area will continue, thereby creating a need for technical program development, then the advice and assistance of an advisory council may be a long-term necessity, and great care should be given to the formation and support of the association. Mistakes that lead to alienation between representatives of the college and industry could be costly and difficult to resolve later.

2. **What role is envisioned for the council?** In establishing an industry advisory group, it is important to tell the members what the anticipated outcomes are and what the powers of the council will be to achieve those outcomes. That is, will the council strictly advise or will it direct the planning activities? In some instances, the college(s) may look to council members and their firms for special assistance apart from identifying new technical training areas. In other instances the college(s) may need the council to act as a "booster" group for programs that support high technology. High-technology firms often support local athletic teams and charitable causes in order to promote their image as good corporate citizens. Many are also likely to be willing to

support programs that affect the productivity and profitability of their firms. In addition, many council members may be willing to testify before the state legislature in behalf of improved funding measures for technical training programs.

3. **What definition of a "high-technology" firm should be used?** Determine if a very broad definition is needed to include all types of firms in the local area, or whether the definition should be more focused on specific "high-tech" firms that produce a particular product in the electronics, computer, communications, energy, aerospace, or other high-technology industries. Firms producing a high-technology product may or may not be using sophisticated, automated, computer-controlled manufacturing systems. With an appropriate definition, at least ten or more firms should be eligible for membership on the advisory council.

4. **What firms, organizations, or persons will be on the advisory council?** Depending on the anticipated role of the council, the college(s) may wish to extend membership not only to representatives of the high-technology manufacturers, but also: to members of the local chamber of commerce; to bankers who help finance capital expansions of high technology and assist firms to plan for sites and expansion of energy needs; to executives of software firms that develop programs for computerized systems; to top administrators of personnel firms that contract temporary technicians and engineers to other firms; to architects and contractors involved in the design and construction of plants; and to members of the local media who can articulate the goals of the council to the community. Some of these potential council representatives will have established status in the community, and their knowledge of local politics could be advantageous. Others will be able to provide excellent consulting for facility construction and remodeling or staff hiring.

Colleges should also consider including smaller high-technology firms in anticipation of their growth and expansion to a level requiring the establishment of national corporate headquarters offices in the community. Councils should include representatives of the college(s) so that faculty and administrators obtain firsthand communication from the industries, and can inform the companies about the college(s) and training programs. The number of college members should be kept small relative to industry representatives in order to avoid "intimidation by numbers."

5. **What level of administration or supervision should be represented by each firm or organization on the council?** Department heads, engineering group leaders, or production supervisors usually know what technical skills are needed for job performance and, therefore, they usually make the best members for advisory committees for specific programs. However, top corporate executive(s), such as chief executive officers (CEOs) and operations management personnel, are also desirable as high-technology advisory council representatives, because they have corporate authority to make commitments, donations, and provide semiconfidential hiring data from the corporations. Top-level operations executives also tend to have a better idea of the future directions of a firm, its corporate budgeting, and its donation and foundation programs, and can obtain cooperation from personnel and training departments to respond to surveys.

6. **Who can assist the college(s) in putting the council together?** If it is decided that representation by high-level corporate executives is needed for the success of the council, then chief executive officers of the firms or organizations should appoint such individuals to provide assistance. Getting the attention and cooperation of the CEOs can be difficult unless the college presidents have a good working relationship with them. A letter from a trusted colleague in the community inviting CEOs participation can be very effective.

7. **Who will chair the advisory or planning council?** The chairperson should be an industry representative, and the advisory council members should select the chairperson after they have had an opportunity to become acquainted with each other during council meetings. Later, the council may wish to form subcommittees, depending on how large it becomes and how many issues it addresses.

8. **What support will the college(s) provide to the council?** Careful thought should be given to the selection of the college representative(s) assigned to work with the council. The person(s) selected should hold a leadership position in the college administration, be skilled in group relationships, be sensitive to and knowledgeable of corporate organizations, have the authority to make commitments on behalf of the college and to accept or reject donations, and the power to elicit administrative and faculty support. The president(s) or chancellor(s) of the college(s) should also plan to participate on the council, and attend every meeting. College staff should be made aware of the fact that high-technology corporations are concerned about safeguarding new products and processes they have under development, and that college representatives must respect the confidentiality of any such information to which they are made privy. Also, company representatives may occasionally need to withhold information.

9. **What information and resource support will the college(s) need to carry out the planning functions?** In addition to determining program improvements and modifications or to developing new programs, the college(s) may need to obtain information on future directions of local high-technology firms in order to project long-range plans and costs. The college(s) may also need to tap council members to obtain consulting services, to find opportunities to update faculty through summer work in industry, to obtain equipment donations, and to gain access to part-time instructors.

The college(s) should consider an in-house assessment of occupational programs to determine such items as the number of current programs that are related to high technology and the date when they were last revised. Enrollment and placement information should be updated if not current. Results of any follow-up studies should be reviewed. An up-to-date status report should be prepared for the advisory council to indicate current program costs, condition of equipment and facilities, and faculty needs for technological retraining or updating.

10. **What benefits will accrue to the firms for their participation?** Chief executive officers and their representatives should be made aware of the benefits resulting from participation in the advisory council. Of paramount importance is the opportunity to influence technician training and the quality and quantity of program completers. The closer trainees' skills approximate those needed on the job, the less training industry must do; and the less in-house training required by industry, the more dollars are available for research and development, capital replacement, or expansion. The result of such training efforts could mean more jobs overall.

Another benefit that firm(s) can obtain from advisory council participation is the retaining of current employees. Upgrading valued employees who already represent a corporate investment provides a new pool of technical skills.

Many firms believe that participation on high-technology advisory councils provides better opportunities to target and hire graduates. Other firms make good use of their participation to generate opportunities for their engineers and technicians to gain teaching experience, which can enable these persons to contribute more effectively to in-house training programs.

11. **What commitments to long-range, high-technology programs can the college(s) make in dollars, staffing, facilities, and equipment purchases?** If the advisory council members are

expected to make long-range commitments, the college(s) should also demonstrate commitment. For example, the college(s) should attempt to project, over a five-year period, the funds that will become available for facilities, remodeling, and equipment as well as for replacements for retiring faculty or for new slots that can be targeted to new program areas.

12. **What priority will the occupational programs that support high technology enjoy in relation to other programs and services of the college(s)?** It is important that the advisory council members understand that high-technology training is not the only business of the college. They should further be aware of important commitments that have been made over many years to a broad spectrum of occupational programs, and that additional resources are being committed to those existing (and potential) programs that support high-technology training. Limitations on resources are an inescapable fact of college operations.

13. **How can council members become familiar with the college(s)' operational procedures and pace?** College systems have some unique ways of providing funding and of conducting program revision and approval processes. If advisory committee members are aware of these processes, they will be more tolerant of the fact that their recommendations must move through a series of internal (and sometimes external) reviews. The council members should receive brief tours of current, related programs to observe equipment and facilities and to meet faculty. They need to develop a familiarity with the total institution in order to have a reasonable background for planning. Members should be given college catalogs, program brochures, course outlines, or other available material that best represent current programs.

14. **How can the college(s) maintain long-range commitment from the council?** It is advisable to plan meaningful activities that members can support in less than one year, while working on longer-range objectives. Publicity in the local media and in corporate employee newsletters will aid in sustaining motivation. At the end of the first year of the council's activity, an appreciation event sponsored by the college president is recommended. This event should provide an opportunity to review and highlight council accomplishments, as well as to promote enthusiasm for events in the coming year.

PART 3

STEPS FOR SUCCESSFUL HIGH-TECHNOLOGY PROGRAMS

Part 3 presents the thirty-step process recommended for creating successful high-technology training programs. Five major phases of activities should occur. They are: (1) long-range planning, (2) program planning, (3) development, (4) implementation, and (5) evaluation and refinement. The sequence of steps contained within these phases is illustrated in figure 1.

Each step or activity is discussed here in detail, along with important "do's and don'ts." Following the discussion of the thirty steps are a succinct summary of the steps as well as a summary of the do's and don'ts.

Phase 1—Long-Range Planning

STEP 1: **Establish a high-technology advisory council**

To provide guidance on the current status and future needs of high technologies, representatives from leading industries in the area utilizing those technologies should be requested to serve on a high-technology advisory council. Industry representatives should include those involved in long-range planning for their companies—individuals who can sense the needs of their companies three to five years in the future. Top corporate planners who have the direct support of their companies' chief executive officers can provide valuable input for college planning.

In addition to industry representation, the council should be comprised of faculty and administrators in the areas from which high-technology training programs likely evolve (e.g., electronics manufacturing, drafting). The council should serve as a resource and "clearinghouse" and will make recommendations concerning the directions the institution should take in high-technology training. The council should also be available for ongoing evaluation of existing programs and of their relationship to anticipated program offerings.

If the institution is located in a geographical area containing many colleges, it may be advantageous to explore the possibility of a cooperative task force for this phase.*

DO:

- Do select professionals from a variety of high-technology fields.
- Do provide an outline of expectations and powers of the council.

*See part 2 for an expanded discussion of advisory councils.

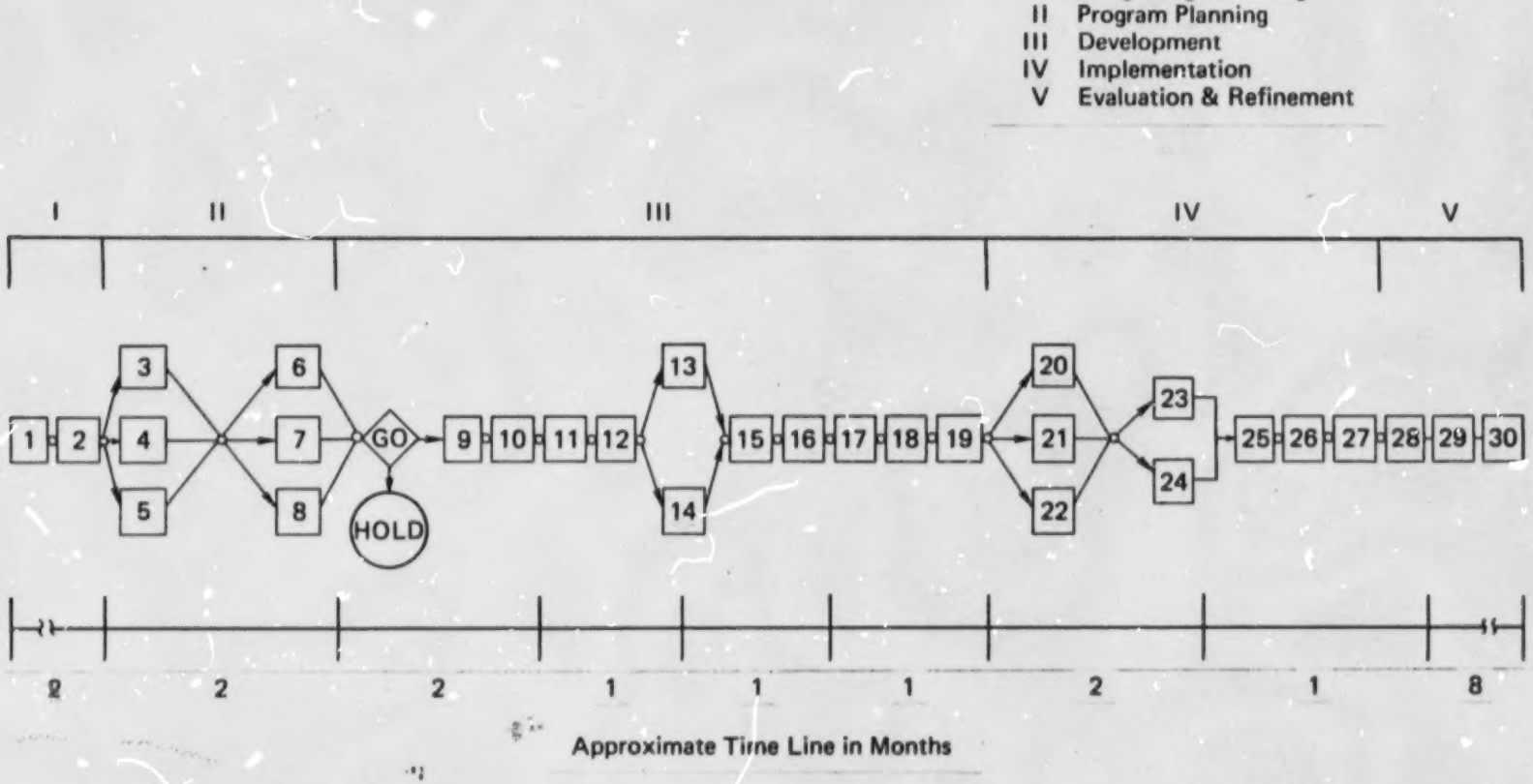

Figure 1. Program Development and Implementation Steps

- Do include faculty and administrative representatives from disciplines likely to be involved.

- Do consider cooperation with other area colleges and universities with similar interests.

DON'T:

- Don't "stack the deck" by neglecting persons from industry who have some reservations about high-technology education. They may provide valuable input, especially on training areas to avoid.

- Don't exclude "traditional" program planners.

STEP 2: **Develop a five-year plan for the new high-technology program(s)**

It is necessary to include long-range planning and objectives in any new program, but it is even more critical—and difficult—for high-technology areas. Unique problems arise for several reasons:

- There may be no models to refer to for guidelines, although some existing programs and courses may serve as stepping stones to new program development.

- The rapid changes in technology and the often prohibitive expense of equipment raise serious and valid questions concerning the feasibility of acquiring needed items or of offering the program at all. Some compromise may be made, for example, by foregoing a dedicated lab in favor of scaled-down equipment and modeling set-ups.

- There is a shortage of qualified people in the field with sufficient background and/or experience to serve either as consultants or faculty.

Adequate time must be taken to evaluate these concerns as early as possible. Developing a five-year plan encourages planning for eventually interfacing high-technology programs with existing and future curricula of the institution.

In addition to anticipated programs and course offerings, the five-year plan should detail expected staffing, facilities, equipment, and supply requirements. Consideration should be given to the substitution of scaled-down but fully operational models of expensive equipment (e.g., robot models) and less expensive versions of system components (e.g., microcomputers instead of full-scale CAD hardware) in order to reduce the large capital outlay of a dedicated laboratory. Projected revenue generation should be estimated. Sequencing of new programs and courses and their relationship to existing or conceived curricula should be specified.

The planning activity should include the assistance of the high-technology advisory council, because the type of programs to be considered may include new content, skill combinations, and proposed program titles uncommon to current college programs.

Most technical colleges already possess a nucleus of programs and courses for supporting high-technology training programs. Programs in robotics, automated manufacturing systems, computer technology, computer-aided design, computer-aided manufacturing, production

management, "high-tech" maintenance, process technology, and communications technology now beginning in colleges across the nation are growing out of the electronics, drafting, machining, quality control, manufacturing process, automotive, and management programs that have existed for years.

To determine whether an additional program is needed or the current program can be modified, the high-technology advisory council should consider designing a survey to be administered to member firms. The survey form should be developed by council members to ensure that the terminology is understandable by industry and that the information requested is available. For example, survey questions might request information on whether firms hire from current programs in the college, on the skill categories in which technicians are needed but training does not currently exist, and on the projected number of new hires anticipated over a given period of years.

After information about local skill and knowledge needs is obtained, the administration, faculty, and council can begin to do the following:

- Determine the needs for program expansion, program modification, and addition or deletion of the courses or new program(s).
- Estimate equipment and facility needs, staffing (full- and part-time), curriculum development support, faculty retraining areas, and related support costs of supplies, equipment maintenance, lab technicians, instructional materials, and printing (e.g., texts may not be available on the subject).
- Arrange the development projects in some order of priority. Priorities may change depending on the assistance provided by concerned firms. Such assistance may include part time staff, equipment donations, cooperative training arrangements that enable students/employees to obtain "hands-on" experiences within the firm, and temporary work opportunities for faculty to learn new skills on the job.

The five-year planning document should serve as a reliable statement of the institution's intentions, but should be adaptable to reflect changes in the economy, enrollment, industry trends, and so forth.

DO:

- Do make an effort to consider more than the immediate program(s) under development. The more thought that is given to interfacing with existing programs and courses, the easier it is to select equipment, facility, and support material. Existing programs and courses often can serve as stepping stones in planning and developing the new high-technology program(s).

DON'T:

- Don't consider the five-year plan to be "cast in stone."

STEP 3: **Develop design criteria and performance goals of the proposed program(s)**

With the assistance of the high-technology advisory council, as much information as possible about the particular high-technology discipline should be assembled and evaluated. From this information, an analysis should be made to determine what skills and knowledge should be emphasized in the proposed program(s). When this is determined, design criteria and performance goals can be detailed. Design criteria should be statements that provide a broad overview of the specific intent and objectives of the program(s). Competency-based performance goals are suggested alternatives to meeting these objectives. If possible, consultants from the industry should be used to ensure that all objectives meet the current and projected needs of the field. Thoughtful attention to design and performance goals facilitates the development of individual speciality courses.

DO:

- Do work with experts in the chosen field.
- Do try to address all related areas.
- Do have specific objectives for the program(s) in mind.

DON'T:

- Don't make the statements so detailed that they do not allow for flexibility in course development.

STEP 4: **Identify department and faculty best suited to support and develop the program(s)**

If the institution has several departments within which high-technology programs could conceivably be housed, an evaluation must be made as to which department(s) best meet the specific needs for the desired outcomes. Decisions must also be made to determine what the goals of the program(s) are—hands-on experience, engineering-related skills, theoretical knowledge, and so forth.

Other considerations that affect these assignments include the ability of the faculty to retrain for the specialty, the availability of faculty to work with corporate representatives to design the program(s), and the relationship of the new program(s) to existing courses.

Given some of the trends in high-technology industries, the best assignment of a new program to a department within a college may not be immediately obvious. For example, a program to prepare technicians to install, maintain, and repair automated manufacturing equipment may need to tap the educational activities that cultivate mechanical skills, as well as those that cultivate learning in electronics and microprocessor skills. This trend of crossing formerly distinct disciplines is taking place today in automotive technology programs, where

competent automotive technicians also need to acquire a firm foundation in electronics and microprocessor-controlled systems. Although several departments may therefore need to share in a new program's operation, specific responsibility and authority should be assigned to one department, in order to assure the future development of the program.

After the department and faculty for the new program are identified, the actual curriculum development can proceed.

DO:

- Do take into consideration the type of instruction planned for the program.
- Do consider backgrounds and adaptability of existing staff.
- Do consider equipment and facility requirements.

DON'T:

- Don't overlook the goals of the program and where in the institutional setting they can be best accommodated.

STEP 5: **Formalize a program advisory committee**

For every program to be developed, there should be a specialized program advisory committee with representatives from industries that are directly involved with the day-to-day operations of the specific technology in question. This committee can provide the institution with essential technical information and resources for curriculum and course content development.

The program advisory committee has the responsibility of (1) defining the overall courses and goals; (2) describing the types of positions for which the program completers will qualify; (3) reviewing existing courses for program applicability; (4) describing the content of new and modified courses; (5) reviewing drafts of course outlines and/or course competency statements; (6) recommending equipment and facilities; and (7) recommending consultants and part-time teaching staff. Persons on this committee should have an appreciation for education and training processes as well as be knowledgeable about the technical aspects of the field.

The members of the high-technology advisory council can be very valuable in securing the best members for program advisory committee(s) from within those firms that plan to hire future graduates of the new high-technology program(s). The training and education departments of companies are also good sources for committee representatives.

A committee should include persons having a supervisory relationship to the kinds of technicians being trained so that the committee members can provide information on skills needed on the job. Supervisors are also the individuals who often make hiring decisions and promotional recommendations, and who look to a college program for new employees if they know the program meets their requirements. Key faculty and administrators involved in the program should also be members of this committee.

Invitations to the potential members should be signed by the chief academic officer or other top administrator at the college. Once interested industry representatives are identified and their participation is assured, a letter expressing acknowledgement and appreciation of their participation should be sent. Also, a packet of information describing the role of the program advisory committee, a brief description of the intent of the proposed program, and the first meeting date should be sent prior to the first meeting.

Minutes of meetings and recommendations of members should be developed in writing and made a part of the curriculum proposal package. The high-technology advisory council should be regularly informed of the advisory committee's progress.

Because many new programs may have implications for baccalaureate programs and student entry requirements in universities, it is a good idea to include representatives from the most appropriate disciplines at local universities and high schools. These representatives can assist in future articulation and help promote the new program.

DO:

- Do check with the training departments of major corporations in the area for recommendations for program advisory committee members.
- Do make a formal, written acknowledgement of appreciation to volunteers. Their input and support will have a significant impact on the credibility of the program.
- Do provide members with guidelines of expectations.

DON'T:

- Don't neglect small industries when selecting committee representation. These "job shops" account for a large percentage of usage and employment in high-technology fields, though at a slower pace. They may project a more realistic growth rate than larger interests.

STEP 6: **Establish faculty, administrative and community support**

It is essential that those faculty, administrators, and community people to be included in the development and implementation of high-technology programs be involved at the earliest possible point in the process. If the long-range planning activities listed in Step 1 have been undertaken, this involvement should not be too difficult to accomplish. Faculty and administrators will have been alerted to the college's priority on high-technology programming, and will have completed a self-review of the status of current programs and personal needs for updating training.

Faculty input should be solicited regarding supportive and "feeder" courses, and administrative support should be obtained regarding the programs' adherence to the institutional plan. Their support will have been reinforced through their involvement in advisory council and program advisory committee activities, including the identification of resources that can be pledged to the effort. Similarly, representatives of local firms on the high-technology advisory council will be aware of ongoing activities and plans to meet their specific training needs.

At this point, the local television and print media should begin informing the community about the new plans and activities underway for new programs and existing offerings. If the education news reporters for local newspapers are occupied with other issues, it is likely that the business news staffs will be interested in items or feature stories on high-technology developments. Invite media representatives to a high-technology advisory council meeting and/or program advisory committee meeting. Precede the invitation with a press release and a synopsis of some of the research information that lead to the decision to develop a given program or program modification.

These activities should inform the community of the future training oportunities and should also demonstrate the college's concern for and responsiveness to new technical training needs.

DO:

- Do include all vital college personnel from all levels in the development process as early as possible.
- Do utilize resources in the community for both input and publicity.

DON'T:

- Don't overlook faculty or administrators in departments whose courses will be needed for supportive instruction and whose enrollment may be drastically affected by new program development.

STEP 7: **Develop a first draft of program requirements and specifications**

Before input and assistance can be requested from the program advisory committee or other consultants, a preliminary outline of the new high-technology program must be developed. This may be compiled with the aid of the high-technology advisory council. A working document containing the recommended curricula—including suggested supportive courses as well as tentative specialty course titles and descriptions—should be available for review in time for the first program advisory committee meeting. It should be stressed that the contents of this document are tentative and will likely be revised and updated, as necessary, based on the recommendations of the program advisory committee. Additional items that should be included in this preliminary packet are: (1) suggested faculty qualifications and staffing recommendations (e.g., paraprofessionals, lab assistants), (2) equipment requirements, (3) instructional material suggestions, and (4) facility requirements (e.g., renovation of existing facilities, new facility construction, facility rental, leasing from available sources). Budget projection may also be a part of the process.

Institutional formats should be kept in mind when preparing the layout of this document. This will facilitate transfer of the information from the rough draft to required forms as necessary. The document should always be viewed as a base from which to work and which will undoubtedly undergo many refinements.

DO:

- Do consider the first program specifications list to be a working draft, and expect changes to occur in it.
- Do have the document available for review at the first program advisory committee meeting.
- Do include all relevant activities and projected expenses, not just curriculum content.

DON'T:

- Don't neglect institutional requirements for program and course approval.
- Don't neglect state and regional requirements for program and course approval.

STEP 8: **Analyze cost-effectiveness of program(s)**

One of the most controversial issues in the development of high-technology training programs is the expense associated with them. Technology is changing rapidly, making the most recent developments obsolete in a very short period of time. Careful analysis must be made of this situation for each new program under consideration. At this time, an evaluation of alternatives should be made concerning equipment (e.g., purchase, lease, consignment, time-sharing with industry, grants) and facilities (e.g., renovation, construction, lease, rent). Along with the acquisition of these items, consideration must be given to maintenance and service contracts and other special requirements (e.g., climate control, space allocations, noise control, power requirements). The projected costs must be carefully weighed against the benefits of offering such high-technology programs. Some issues that must be taken into account include revenue production, employment opportunities for graduates, institutional or governmental goals and objectives, client or community demand, and so forth.

This is the first major decision point at which the college must decide to continue, postpone, or discontinue the plans for high-technology offerings.

DO:

- Do evaluate carefully all costs associated with the program (e.g., for training, equipment, facilities, and so forth).
- Do try to project a reasonable time line for paying back the capital investments in the program.
- Do consider all alternative methods of offering the training.

DON'T:

- Don't continue with development if quality instruction is compromised by high costs and slow or no pay-back. There must be complete support for the program to succeed.

- Don't ignore the possibility of postponing the program. Waiting may make it much more viable.

Phase 3—Development

STEP 9: **Submit appropriate applications and budgetary documents as required by institutional procedures**

If the decision is made to continue with program development, this is the time to begin the institutional approval process. Any required proposal forms or budgetary documents should be prepared and submitted as per institutional procedure. This should be done early to provide adequate time for the approval process to be completed and to avoid delays at critical points later.

DO:

- Do follow all procedures as necessary.

DON'T:

- Don't forget that these are new (and sometimes threatening) areas and concepts for some people. Be prepared to do more explaining of procedures, applications, and outcomes of such programs.

STEP 10: **Convene program advisory committee**

- Review and refine curricula and speciality courses.
- Solicit advice for the development of a finalized equipment list and methods of procurement.
- Plan an employer needs assessment.

At the first program advisory committee meeting, introductions should be made of all members. The expectations of the college for the committee should be summarized in terms of assistance with curriculum development, equipment and facility requirements, program evaluation, and so forth. A projection of the frequency of meetings is also helpful to participants. Generally, the committee will need to meet often (e.g., once every two months) during the actual development of the program, and then meet only once or twice per year afterward. After the critical sequence of meetings during the development stage, the committee's function becomes one of ongoing evaluation to assure that the program stays abreast of industry and occupational requirements and developments. This type of feedback does not require frequent face-to-face contact. Annual or semiannual meetings do, however, help promote feelings of continuity and involvement.

The working document prepared in Step 7 should be distributed to all committee members. The suggested curricula should be carefully reviewed. The appropriateness of sequencing and supportive courses as well as credit hour requirements should be examined. The proposed specialty courses should also be reviewed. Initial feedback should be noted from the meeting.

One method of fine-tuning course descriptions that works well is for committee members to select one course in their area of expertise and work with it during the following week. Revisions and suggestions can then be submitted either in writing, through the mail, or by telephone. There should be one person at the institution designated as the contact person to receive and compile these comments and/or materials.

The program advisory committee should provide valuable input about the type and amount of equipment needed for training. Considering the expense of acquiring this type of equipment, the members should be queried about alternative methods of procurement. Some industries are willing to permit time-sharing of computers, to help defray the cost of mainframes. Some vendors—in exchange for being allowed to set up and demonstrate equipment to prospective buyers—may allow use of their equipment on a consignment basis. Leasing (rather than purchasing) equipment may be considered for those areas in which technology is changing rapidly. Companies may donate equipment that is outdated in industry, but which still has adequate applications to instruction of concepts. Approximate price ranges should also be determined at this time, and basic facility specifications should be addressed to coincide with equipment requirements.

Placement possibilities for graduates are an important consideration for any occupational program. The advice of the program advisory committee should be of particular value in determining targets for employer needs assessments and publicity materials. Professional organizations and unions should not be overlooked.

After the curricula and specialty courses are finalized by the program advisory committee, and results are obtained from the needs assessment, the next meeting can be called to update the members.

DO:

- Do make sure all program advisory committee members understand the committee's function.
- Do stress the importance of each member's contribution.
- Do utilize this committee on an ongoing basis.
- Do keep members abreast of all developments concerning the program at the institution.
- Do include the names of industry representatives in publicity information packets.

DON'T:

- Don't take for granted that representatives from industry understand the procedures for program development. Enlighten them.
- Don't neglect industry representatives when giving credit for the program later.

- Don't underestimate the importance of a well-organized and representative program advisory committee in documenting the support from industry and the credibility of the program.

STEP 11: **Conduct needs assessments on both employer and student interest in the program(s)**

In order to determine employment outlooks for graduates of the new program, a survey of job opportunities must be conducted. This survey should be targeted for current potential employers and for those companies that might logically be expected to enter the field in the near future (e.g., traditional drafting or design shops for graduates of CAD programs). Realistically, there will be no actual graduates of the program for two to four years. This makes it necessary to request information about future employment projections as well as about current needs.

The employer survey may also include questions about their needs to upgrade or retrain their employees, and whether the new program would meet those needs. Additional queries about the levels of education and approximate salary ranges appropriate for jobs in the particular field should also be considered. Salary ranges could serve as a drawing point for recruitment literature.

If the employer survey is conducted early enough in the program development process, it can serve as an additional resource for appropriate curriculum content. A brief description of the program, followed by a list of suggested components, will fulfill this objective. The components should have a rating scale to determine their importance to prospective employers. Blanks provided at the end of the list give respondents an opportunity to add ideas.

An often used approach to developing a curriculum plan is through the **D**evelop **A** Curricul**UM** (DACUM) process. DACUM produces a profile of competencies required in an occupation and can also be used as an evaluation instrument for training programs.*

Student interest surveys serve two purposes. The most obvious is a preliminary determination of current interest in pursuing training and education in the particular area. The second is one of publicity, as well as presenting students with new options perhaps never before considered. The questionnaires need to be administered both to current college students and to high school students. The survey for current college students should include questions about (1) immediate interest in the proposed program, (2) intent of attending full-time or part-time, (3) pursuing the degree or certificate or just taking a few courses for special interest, (4) willingness to change declared major, and (5) desired outcomes (e.g., new job, advancement, and so forth). The high school survey should be similar, but need not go into quite as much detail.

DO:

- Do use a variety of sources for suggestions regarding to whom the survey should be directed.
- Do use the questionnaires as instruments to gather information about as many areas relating to the program as possible.

*Appendix B contains a description of the DACUM process.

- Do keep the survey instruments simple in order to ensure a better rate of response.
- Do organize the survey instruments so that results can be compiled and analyzed easily.
- Do ask typical small groups from each target audience to review a draft of each survey instrument, and revise it based on the criticism given.

DON'T:

- Don't be discouraged by a low percentage of response. Perform follow-ups as necessary.

STEP 12: **Analyze the needs assessments**

After receipt of responses to the two needs assessments (in Step 11), a comprehensive analysis and interpretation of the results must be performed. Employment opportunities must be tallied. Responses must be reviewed for feelings about the appropriate level of education required for the positions sought. The anticipated growth rate in the field should be checked by comparing the current employment capacity to what is projected for the next year and the next five years. The growth rate must be taken into consideration especially in the high technologies, since they are areas that not all companies will have started utilizing. For this reason, even though the immediate employment opportunities may not be great, the projected ones are extremely important. If curriculum component feedback was solicited, compare the ratings of the given components to their planned importance within the curriculum as it was designed. Review written-in suggestions to see if any necessary aspect has been overlooked. Check whether employers would recommend the program to their present employees for upgrading. Positive responses to this last question can be considered an endorsement of the concept of the proposed program.

Student interest surveys can provide a basis for estimating the number of persons considering training in the particular field. This may aid in determining staffing and course requirements. Responses must be compared in terms of passing interest versus genuine commitment to following through with the training (e.g., would like to take a few courses versus would pursue a degree).

When comparing the employer responses to the student interest responses, three distinct outcomes can occur. Ideally, employment possibilities and student interest will balance. If employment opportunities are strong but student interest is low, the institution may wish to undertake an aggressive publicity campaign to educate current and potential students about the possibilities. (At this point, impressive salary figures are helpful. It is possible that the public is not yet aware of what these new fields have to offer. The educational forum may help to fill this gap). If, on the other hand, there is high student interest but low job opportunities (even in the long-run), the institution should seriously evaluate the reasons for offering the program at the present time. In the current economy, there cannot continue to be programs that produce well-qualified graduates for nonexistent careers.

The results of the surveys bring the college to another critical decision point about continuing the development of the new program(s).

DO:

- Do use responses carefully to evaluate the direction the program should take. Where are the needs?
- Do make a careful assessment about the viability of the program. Are there actually opportunities for graduates at this level?
- Do utilize responses to assist in determining the directions for publicity.

DON'T:

- Don't ignore negative responses. Carefully review the reasons for them.

STEP 13: **Determine equipment requirements**

With the assistance of the program advisory committee and/or available consultants, specific equipment requirements for the new program must be determined. The ratio of equipment to students must be taken into consideration. Equipment that is adaptable to changes and expansion is more economical in the long run and should receive strong consideration. Retrofitting of existing equipment should also be explored.

Special attention should be paid to what is to be taught in the program. If required theory and applications can be presented on less than the top-of-the-line equipment and then easily projected to real-world situations, perhaps the program can use less expensive equipment. For example, in a computer-aided drafting modification to the drafting program, it may seem that twelve student stations with sophisticated equipment costing $50,000 per station are needed. Further investigation may reveal that one or two such stations will suffice, and that a few microprocessor-modified stations costing under $10,000 each will provide excellent simulated experiences.

On the other hand, the quality of instruction must not be sacrificed for the sake of economy. Equipment that is not representative of what is actually used in industry is not a bargain, regardless of the price. The goals of the program must not be compromised.

Equipment must also be selected with space consideration in mind. Multiple numbers of certain items may be desirable for instructional purposes, but may be out of the question in relation to facility size. In this case, class size should be reviewed. In addition, support and service requirements of equipment should be carefully analyzed. If computers are required, the software should be identified and chosen before the hardware is selected.

At this point, equipment lists should be as close to final as possible.

DO:

- Do consult with experts in the field to see what equipment suits education and training needs best.
- Do consider student/work-station ratios.

- Do check with vendors to compare educational support packages.
- Do check up on what equipment industry is using and try to find affordable program equipment that will conform.
- Do consider space restrictions.

DON'T:

- Don't be pressured into purchasing top-of-the-line equipment if the same applications and concepts can be taught with less expensive models.
- Don't sacrifice instructional quality for inexpensive (but obsolete or inappropriate) equipment.

STEP 14: **Submit grant and/or funding applications**

If the college administrators decide to continue with the development of the new program, funding assistance should be sought. If possible, monies for consultants should be requested (unless free consulting services are available from local corporations). All aspects of program development should be considered. Special contract costs, support personnel, supplies, publicity, and the like are all realistic expenditures.

Some sources for funding are the state departments of education, trade or professional organizations (such as the Society of Manufacturing Engineers), and corporations dealing in the high-technology fields. The Jobs Training Partnership Act puts a high priority on retraining displaced workers, so the state governor's office administering the Act should be contacted as well.

Many of the larger national and international corporations have foundations. Frequently, the policy of the foundation (and the corporation) is to support educational and humanitarian projects only in those communities where a major corporate facility is located. These opportunities should be pursued, as decisions to support a project often are made on the basis of the benefits the project activities will produce for the corporation or its employees.

When available, matching funds for equipment should be sought as soon as the finalized list is developed. Again, it must be stressed that all possible alternatives for procurement must be explored, because of the high costs involved.

DO:

- Do investigate all possible sources of funding.
- Do detail all aspects of program development and implementation.

DON'T:

- Don't forget to check with corporations for equipment donations.

- Don't neglect pertinent professional or trade organizations.

STEP 15: **Analyze and develop specifications for facility and equipment requirements**

After the equipment specifications list is finalized, plans for facility construction, renovation, or adaptation must be developed. Special requirements for proposed equipment must be considered. Ventilation, drainage, floor strength, soundproofing, temperature control, dustproofing, and sewage and airborne emissions control are essential considerations for high-technology lab equipment. Space allowances must permit safety clearances around the entire work area in order to house moving items (e.g., robots). Safety shields are often necessary for demonstrations.

If classroom space is required within the lab areas, this space must be incorporated in the design of the facility. Demonstration areas should be set aside with enough room for groups of students to view the entire process as it is demonstrated. Door heights and widths must permit the largest pieces of equipment to be brought in.

When major remodeling or new construction is planned for a program, it will probably be necessary to engage the services of a registered architect to assist in developing building specifications. The faculty and administration need to be involved with the architect in determining the educational and other requirements for the facility.

It should be evident that there is more than just square footage to be considered when designing such a facility. Power, lighting, and water supplies are vital to efficient operation of all aspects of high-technology training. Storage space for supplies and tools must be included. All these items should be handled at the preliminary stages of development.

Rapid technological change requires that training programs continue to be responsive to innovations in facility design. The use of such innovations such as movable partitions and modular office spaces may help make future remodeling activities less expensive.

DO:

- Do make sure that facilities allow for all equipment support requirements.
- Do permit faculty to assist in facility planning.

DON'T:

- Don't forget safety requirements.

STEP 16: **Prepare bid specifications**

Once equipment and facility requirements are known, they must be prepared in a format for bid requests. When specific brands of equipment are required, they should be noted, including the rationale. Where options and features are necessary, they should be specified. If a particular

brand is not vital, alternative makes or models with the desired features should be indicated. The entire equipment list should be prepared in this manner and requests for price quotations sent to appropriate firms known to be reputable suppliers of the type of equipment desired. The program advisory committee is a good source for recommendations of suppliers.

Facility requirements should be similarly detailed. It should be made clear where compromises will and will not be tolerated. Safety requirements should in no way be slighted. All specifications should be detailed. Again, whether it be for renovation of existing facilities or for new construction, bids should be solicited from reputable architectural and construction firms.

DO:

- Do provide guidelines about where substitutions and/or alternative selections will be considered.
- Do deal with reputable suppliers and firms.
- Do think about future as well as current equipment and facility needs.

DON'T

- Don't forget that the program advisory committee may be a good source for suggestions.

STEP 17: **Submit program(s) and courses for institutional review and approval**

At this point, the program and its speciality courses should be well on their way to being firmly conceptualized. All preliminary reviews should have been completed in Step 9. Final preparations should be made now for institutional approval of the curricula. Any committee members, department chairpersons, or administrators whose endorsements are required should be fully apprised of all aspects of the program. Any remaining questions or concerns should be resolved.

This stage may prove to be quite challenging. There are few if any model programs with which to compare proposals. The vocabulary and concepts involved in high-technology areas are unfamiliar to most people except as "buzzwords" seen and heard in the media. There tends to be both a fascination for and skepticism about this field. High technology is seen as a venture into the unknown. As a result, there may be a need for stronger public relations and information campaigns both within the institution and outside it than generally are used for more traditional programs.

DO:

- Do make sure that all concerned faculty, administrators, and staff are fully apprised of the program and its intent.
- Do follow institutional procedures.

DON'T:

- Don't discount the possibility that extra public relations or informational sessions may be required to overcome skepticism than are generally needed for more traditional programs.

STEP 18: **Obtain facility and equipment bids**

When responses to bid requests begin returning, they must be carefully reviewed. Several things must be checked in addition to the actual lowest dollar figure. For example, college administrators must ascertain whether required specifications, features, options, instructional packages, and so forth are included in the quotations. Delivery and installation conditions should be read thoroughly and understood. Service contract requirements must be carefully examined to assure compliance with all desired specifications.

Facility bids should also be scrutinized for conformance to specifications, and safety requirements must be kept at the top of the list.

DO:

- Do carefully review all proposals to ascertain that they meet all requirements.

DON'T:

- Don't compromise the quality of the program for the sake of the lowest dollar figure.
- Don't sacrifice safety.

STEP 19: **Begin facility renovation or construction**

When contracts are awarded, construction and/or renovation should begin immediately. Locations for new facilities should be chosen both to blend into the present feeling of the institution and yet to set it apart as something new and different. If the college does not have a construction manager, an administrator should be appointed to check regularly that construction is proceeding according to schedule, review any construction changes, and obtain necessary approvals for changes in construction or materials used.

DO:

- Do begin construction as soon as possible to facilitate timely set-up.

Phase 4—Implementation

STEP 20: **Order equipment and materials**

Based on the bids reviewed, appropriate suppliers of equipment for the program should be selected and the required items ordered. At the same time, instructional materials should be ordered. Textbooks, audiovisual aids, and so forth must be acquired in time for efficient program start-up. Any consumable supplies needed for equipment operation and maintenance should also be on hand for start-up. All these things should be available as soon as possible, especially those specifically needed for introductory courses. Few things hurt the credibility of a program as much as having to improvise instruction around inadequately prepared laboratory settings.

DO:

- Do order supplies and materials required for support and maintenance of equipment.
- Do ascertain that all peripheral requirements for the program are ordered.

DON'T:

- Don't forget teaching aids when ordering materials.

STEP 21: **Retrain current faculty and/or hire new faculty**

Faculty retraining requires considerable time and forethought. Learning new technical applications and gaining practical experience in industry are especially important for existing full-time faculty, who may not have kept current with recent advances in their fields of expertise.

If possible, existing faculty from "traditional" areas that are easily integrated into high-technology applications should be trained to staff these areas. This approach is especially desirable for faculty who teach in traditional areas with declining enrollment or very slow growth rates. The first step in this process is for faculty members and administrators to determine the skills and knowledge to be acquired and determine which faculty should be retrained. Retraining might be accomplished through sabbatical leaves, seminars, conferences, or programs from vendors. Consideration should be given to offering short sabbaticals for a summer or one school term.

Faculty exchanges in some instances may enhance faculty expertise. Since many universities do not yet offer courses in the newest technical applications, and since seminars and conferences are usually too brief or too general, the best opportunities for upgrading faculty members' knowledge and skills are in industrial work experience, such as a cooperative education position with a high-technology company. If industry experience is the most viable alternative, the next task is to match faculty members' training needs to those available in local firms. If it is not possible for firms to pay faculty salaries, sabbatical pay or extended contract pay are alternatives to consider.

If preferred, new faculty may be hired for the program. It is recommended that these persons be well-versed in current applications of the field, as well as having strong instructional abilities and understanding of educational objectives and priorities. Obviously, the capability of the instructor person to adapt easily to the changing requirements of both education and industry is a favorable asset.

Securing new staff can be as challenging as developing retraining opportunities for current staff. Colleges compete with industry for the same talents, and the corporations usually outbid educational institutions in the salary war. Faculty applicants should be carefully screened to avoid hiring industries' rejects. Creative recruiting must frequently be coupled with provision of a year or so for the recruiting process.

Other alternatives are to hire skilled employees of local firms to teach inservice specialty courses for faculty in the evenings, early mornings, or weekends.

DO:

- Do make an effort to retrain existing instructors.
- Do try to select new faculty who have an understanding of the relationship between education and industry.

DON'T:

- Don't neglect program advisory committee members when searching for qualified new instructors.
- Don't neglect program advisory committee members if you are retraining existing instructors.

STEP 22: **Publicize new programs**

Using the same mailing list as for the needs assessment, publicity information should be distributed announcing the implementation plans for the program. The program advisory committee can assist with this phase (e.g., in members' speaking engagements, when program activities and accomplishments can be described). Professional and trade organizations often have their own publications in which new training programs can be announced.

An aggressive publicity campaign should be directed toward potential students at area high schools. The program, curricula, facilities, equipment, job opportunities, and salary scales of graduates of such programs are good selling points.

Media publicity may also prove effective. Newspaper articles, radio interviews and reports, or television feature articles often highlight educational opportunities. Strategic use of press releases about facility renovation or construction, equipment acquisitions, and so forth can serve as effective publicity.

Using the media to publicize new programs was first mentioned in Step 6 and should be continued appropriately throughout the program planning and implementation process. Entice the media with good information about growing enrollments, nontraditional students, new equipment and facilities, and the like.

An attentive eye should be kept open for articles regarding high-technology applications in new or nontraditional fields. When such items are found, the information may lead to a new industry to which publicity mailings can be targeted.

DO:

- Do send publicity materials to all who were surveyed for the needs assessment.
- Do utilize press releases when major steps are taken in program development.
- Do publicize the new program to high school students and to industries having even remote ties to the field.
- Do involve the college(s)' public relations office in this effort.
- Do involve the college(s)' student recruiting (admissions) office in this total effort.

DON'T:

- Don't discount the publicity impact of prospective job titles and salary levels for graduates of the new program.
- Don't neglect opportunities that program advisory committee members may use to promote the program.

STEP 23: **Occupy and set up facility, equipment, and materials**

When the facility is finished, it should be set up and occupied immediately. Accurate inventories developed at this time will make future recordkeeping and updating easier. Laboratory and classroom layouts should be reviewed and pilot tested for effectiveness. Materials and supplies should be cataloged and stored with consideration for both security and accessibility. Auxiliary items, such as screens, chalkboards, desks, and so forth, should also be put in place at this time.

DO:

- Do begin to occupy facility as soon as possible.
- Do keep accurate records and inventories of incoming equipment and supplies.
- Do consider both accessibility and security in storing supplies and equipment.

DON'T:

- Don't delay in setting up the facility.

STEP 24: **Prepare detailed course syllabuses**

Using the design criteria and performance goals developed earlier, a syllabus should be developed for each speciality course. Specific objectives, demonstrations, assignments, and other activities should be detailed. Since the courses are being taught for the first time, adjustments should be anticipated; however, the more thought given to structure before starting the courses, the smoother the flow will be, even with the changes. A blueprint with appropriate adjustments is much easier to follow than an attempt to see what happens as you go along. Consistency among instructors is much more attainable and shows students that an amount of preparation and thought has gone into the course offering. Grading procedures, classroom policies, and so forth should be spelled out in course syllabuses to provide students with a clear indication of institutional expectations as well as with guidelines with which to determine the students' own plans and expectations.

Regular meetings of full- and part-time staff teaching the courses should be conducted to ensure that the material is properly sequenced and that there are neither gaps nor unnecessary repetition in instruction.

DO:

- Do detail all specific requirements of courses.
- Do begin with a competency-based curriculum.

DON'T:

- Don't allow instruction to deviate from the outline anymore than necessary to guarantee that all students are receiving the same instruction and have the opportunity to start succeeding courses at the same level.

STEP 25: **Conduct orientation for new and/or part-time faculty**

To assure that all instructors of the program are aware of the institutional objectives, it is advisable to hold an orientation and information session with all involved faculty. This session should include a review of the syllabus for the course to be taught. Textbooks, audiovisual aids, field trips, and so forth should be presented for review and discussion. Procedures for requesting audiovisual equipment, typing and duplicating services, or other materials or services should be presented. College policy regarding necessary forms required for payment, absences, classroom usage, class cancellations, and the like should be reviewed. Evaluation forms may be distributed along with an explanation of the methods used. In general, anything that will facilitate the instruction of the program in a uniform manner should be reviewed. Questions should be answered about any topics of concern. If possible, all support personnel should also be available

for introduction at the meeting. If available, a general handbook of institutional guidelines and procedures should be distributed.

DO:

- Do include all people who will be teaching the new courses.
- Do present as much information about expectations and procedures as possible.

DON'T:

- Don't neglect questions or concerns.

STEP 26: **Provide high-technology counseling**

One person should be designated as the counselor for high-technology programs. This should be done before publicity is released, thereby providing a contact for student inquiries. Student access to a counselor is especially critical if the specialty courses for the program are not expected to be implemented during the next term. Students can then be directed into the necessary supportive courses in the interim. Student-counselor interaction also affords a good opportunity to schedule assessment of competency levels, where required. If developmental work in mathematics or communication skills is needed by some individuals, this is a good time for them to get started. An effective and readily accessible contact person can do much to promote success and continuity in the program. A videotape or slide-tape presentation showing job scenes for each high-technology program would also be valuable for the counselor to use with both students and faculty.

In the early stages of a new program, the departmental faculty members will be the most knowledgeable persons about the program, including entry requirements, program goals, and employment opportunities. Because they will have been closest to the curriculum development process, they are probably the best counselors for students interested in the new programs.

DO:

- Do provide prospective students with information and with guidance into supportive courses as soon as a new program is officially approved, even if specialty courses are not ready to be offered immediately.
- Do have a specifically designated person (or persons) to disseminate information and handle inquiries.

DON'T:

- Don't overlook the opportunity for developmental education for students in need of basic skills remediation.
- Don't allow persons, other than those designated, to answer questions unless they are fully aware of all aspects of the new program.

STEP 27: **Implement the programs(s)**

As soon as the facility is ready, equipment is operable, and staff are available and prepared, speciality courses should be offered as detailed in the curriculum. The sequence should be determined by prerequisite requirements. Feeder courses should be offered every term in order to assure continuance of the program. Sequences should be established to accommodate both full-time and part-time students. Ample opportunities should be provided to upgrade the skills and knowledge of current employees and displaced workers.

DO:

- Do offer courses in a sequential manner with consideration of prerequisites.
- Do consider supportive course offerings.

DON'T:

- Don't underestimate the importance of continuing to offer introductory or "feeder" courses for the continuation of the new program.

Phase 5—Evaluation and Refinement

STEP 28: **Evaluate the high-technology program(s)**

Toward the end of the first term, a preliminary evaluation of the new program should be conducted. Students should be asked to evaluate both the faculty and the quality of the program. Faculty members should evaluate instructional materials, methods, effectiveness and appropriateness of course syllabuses, and so forth. Suggestions for improving the program should be solicited from all students and staff.

DO:

- Do conduct an evaluation near the end of the first term.
- Do consider suggestions made for improving the program.
- Do keep the program advisory committee informed of the evaluation results.

DON'T:

- Don't discount the importance of gathering information from *all* people involved in the program: students, staff, and faculty (both part-time and full-time).

STEP 29: **Adjust courses and teaching strategies according to evaluation results**

After all evaluation results are tabulated, they should be carefully reviewed for indications of shortcomings in any area. Caution should be used when attempting this, since there are bound to be individual students who are not satisfied in any instance, and also because there are always "rough spots" the first time any course is offered. Adjustments and refinements to first-time offerings are usually expected and should not come as a shock to college administrators. It is important to watch for definite problem trends in any area. If and when they are found, solutions should be sought. A recommended method is to call all involved faculty and staff together for a meeting to gather input for remedies. Student representation at this meeting may also provide valuable insights.

DO:

- Do carefully consider the results of the evaluations.
- Do look for definite trends in areas that may indicate a need for change. An indication of such trends will show up in negative findings that are similar for both students and staff.

DON'T:

- Don't be discouraged if something does reflect a need for change. This is to be expected for virtually any new program.

STEP 30: **Continue to review and refine program(s), courses, methods, and equipment as dictated by ongoing evaluation**

As the advanced courses in the sequence are delivered, evaluation should continue and be expanded. Students should still evaluate instructional techniques and faculty should still evaluate the new program. As program graduates are placed in the field, evaluation should also be sought from employers. Valuable feedback regarding the appropriateness of instruction as related to "real world" situations can be obtained in this manner. When the program advisory committee meets, members will usually have input for this aspect of evaluation. Often, either their companies have employed students or they have had contact with companies that have done so and will have firsthand knowledge of both the program objectives and the results.

Equipment and laboratory needs as well as the currency of textbooks and other instructional material should be reviewed periodically. Updating should be carried out whenever possible. There is currently a limited selection of textbooks in some high-technology fields, but there will likely be a rapid proliferation in the next few years.

Through continual review and evaluation, the high-technology program should remain consistent with the needs of students, staff, and industry.

DO:

- Do continually evaluate the program and its courses.

- Do obtain and use information to refine and revise the program.

DON'T:

- Don't overlook the input available from employers of program graduates.
- Don't neglect the input of the program advisory committee when evaluating the program.

Summary Points to Consider

DO'S:

- Do make long-range plans for new programs. Long-range planning (for five years) is extremely important because it allows everyone to know well in advance that certain programs are being considered for development. In addition, planning is viewed as a good management practice. In most cases, spontaneous planning for the development and implementation of new programs is not respected by those who make the budgetary, facility, staffing, and equipment decisions.

- Do update a long-range plan every year to allow the high-technology advisory council to revise the plan as necessary. In some cases, a new high-technology program may be on the horizon and should be added to the plan for development in the next five years.

- Do review and develop every year the programs so designated on the plan. If the high-technology advisory council does not address the plan on a yearly basis—indicating which new program will be developed, delayed to another year, or deleted—the plan loses its validity.

- Do ensure that each new program to be developed has an active, contributing program advisory committee.

- Do ascertain that the new program is cost-effective and has a reasonable pay-back plan.

- Do ensure that the community, business, and industry support and need for the program are justified by the needs assessment.

- Do have appropriate facilities and equipment available prior to the implementation of a new program.

- Do ensure that instructors, whether new hires or existing, are involved in the curriculum, facility, and equipment decisions.

- Do ensure that instructors are well qualified to teach in the high-technology areas. This will require an extensive recruiting effort at least six months prior to the date of implementation of the new program.

- Do evaluate new programs at the end of the first year.

- Do provide adequate time for development and implementation of a new program.

DON'TS:

- Don't develop long-range plans without the involvement of the high-technology advisory council.

- Don't involve disinterested or uncommitted people in program planning.

- Don't develop high-technology courses and programs without the involvement of a technical specialist.

- Don't attempt to implement new programs in an inadequate facility.
- Don't implement a new program without well-qualified staff.
- Don't try to "push" a new program if you do not have support from the decision makers of the college.
- Don't attempt to convince the college's decision makers to support a new program without thorough justification.
- Don't spend time and effort developing a program without an effective pay-back plan.
- Don't allow the college to be placed in the position of considering expensive new programs for development because of pressure by groups wanting such programs for their own special interest.
- Don't overlook existing programs and courses as building blocks for new high-technology programs. For example, the CAD portion of a CAD/CAM program is often an extension of existing drafting courses.
- Don't equate corporate interest with corporate funding. Corporate funds may become available, but only after the college has demonstrated thoughtful planning backed up by institutional commitment and support.

Checklist of Steps

____ 1. Establish a high-technology advisory council.

____ 2. Develop a five-year plan for the new high-technology program(s).

____ 3. Develop design criteria and performance goals of the proposed program(s).

____ 4. Identify department and faculty best suited to support and develop program(s).

____ 5. Formalize a program advisory committee.

____ 6. Establish faculty, administration, and community support.

____ 7. Develop a first draft of program requirements and specifications.

____ 8. Analyze cost-effectiveness of program(s).

____ 9. Submit appropriate applications and budgetary documents as required by institutional procedures.

____ 10. Convene the program advisory committee.

- Review and refine curricula and speciality courses.
- Solicit advice for the development of a finalized equipment list and methods of procurement.
- Plan an employer needs assessment.

____ 11. Conduct needs assessments on both employer and student interest in the program(s).

____ 12. Analyze the needs assessments.

____ 13. Determine equipment requirements.

____ 14. Submit grant and/or funding applications.

____ 15. Analyze and develop specifications for facility and equipment requirements.

____ 16. Prepare bid specifications.

____ 17. Submit program(s) and courses for institutional review and approval.

____ 18. Obtain facility and equipment bids.

____ 19. Begin facility renovation or construction.

____ 20. Order equipment and materials.

____ 21. Retrain current faculty and/or hire new faculty.

____ 22. Publicize new program(s).

____ 23. Occupy and set up facility, equipment, and materials.

____ 24. Prepare detailed course syllabuses.

____ 25. Conduct orientation for new and/or part-time faculty.

____ 26. Provide high-technology counseling.

____ 27. Implement the program(s).

____ 28. Evaluate the high-technology program(s).

____ 29. Adjust courses and teaching strategies according to evaluation results.

____ 30. Continue to review and refine program(s), courses, methods, and equipment as dictated by ongoing evaluation.

APPENDICES

APPENDIX A

SITES VISITED

Postsecondary Institutions

Dr. Russell Jerd, Dean of Engineering Technology
Professor James J. Houdeshell, Department Chairman, Industrial Packaging and Quality Control Technologies
Professor Nataraj S. Nataraj, Department Chairman, Mechanical Technologies, Electrical Repair and Transfer
Sinclair Community College
Dayton, OH

Professor Ed Konopka, Robotics Technology Program
Oakland Community College, Auburn Hills Campus
Auburn Heights, MI

Professor Jack Thompson, Director, CAD/CAM Programs
Macomb Community College
Warren, MI

National Conference on High Technology
Hocking Technical Institute
Nelsonville, OH

Robot Manufacture Users

Mr. Lloyd R. (Dick) Carrico, Applications Engineer
Industrial Robot Division
Cincinnati Milacron Company
Lebanon, OH

Mr. John B. Franklin, Manager
Advanced Technical Training
Chrysler Institute
Chrysler Corporation
Highland Park, MI

Mr. Dana Holmes, Technical Training Coordinator
GM Assembly Division Plant
General Motors Corporation
Lordstown, OH

CAD/CAM Users

Mr. Michael Baxter, CAD/CAM Application Manager
F. Joseph Lamb Company
Warren, MI

Mr. Bruce W. Dobras, Senior Engineering Associate
Monarch Marking
Pitney Bowes Company
Dayton, OH

Ms. Jane H. Frederick, Manager, Engineering Systems
Mead Digital Systems
Dayton, OH

Mr. Mike Kuntz, CAD/CAM Manager
Harris Corporation
Dayton, OH

Mr. George Mahfouz, Engineering Manager
Davison Corporation
Dayton, OH

Mr. David L. Michaels, Engineering Systems Manager
Monsanto Research Corporation
Miamisburg, OH

APPENDIX B

DACUM: A NEW APPROACH TO CURRICULUM DEVELOPMENT

What It Is

DACUM is becoming a familiar word at two-year colleges. It stands for **D**eveloping **A** **Curricul**UM. Basically, it's a one-page profile of competencies. You can use it both as a curriculum plan and an evaluation instrument for occupational training programs.

In a graph form, DACUM defines the competencies required in an occupation. The graph form encourages treating each element of the occupation as part of a larger whole, rather than in isolation.

DACUM is more an analysis of the occupation than a curriculum evolving from analysis. DACUM defines the occupation in terms of the General Areas of Competence it requires.

Each of these areas is then subdivided into those Individual Skills (behaviors) which when combined enable a person to perform competently within that general area.

These skills are defined quite simply and are placed separately in small blocks on the chart. Each can serve as an independent goal for learning achievement.

A DACUM chart also contains a rating scale which allows you to evaluate achievement in each of the defined skills or behaviors. The chart is also a recordkeeping system, because you can record all skill ratings directly on a copy of the DACUM chart kept for each trainee.

Once an adequate skill profile with ratings has been developed, the DACUM chart eventually becomes a diploma or certificate for achievement of skill development in the occupation.

DACUM also has potential for use as a guidance tool prior to entering a training program and as a placement tool upon completion. It has been used to determine entry-level skills as well as a standard for granting credit for experimental learning.

History

DACUM is a new approach to developing curricula combined with a new process for evaluating occupational training programs. It was created initially in a joint effort by the Experimental Projects Branch, Canada Department of Manpower and Immigration, and General Learning Corporation of New York. The corporation provided technical direction to the Women's Job Corps program at Clinton, Iowa.

Early efforts at Clinton were intended to produce a curriculum guide that would increase the trainee's involvement in their training program. The result was a curriculum in graph form, similar

to a time bar chart. Following these early efforts, an experimental DACUM for a typical occupation was developed in Canada as a model for further application.

The idea was adopted by Nova Scotia NewStart. The NewStart people took advantage of DACUM to be able to quickly plan training programs and define them in curriculum form. DACUM also provided a method for evaluating skills and skill change in the training programs. Out of the original intentions and resulting development work, a new approach evolved to occupational training in general.

The DACUM approach has since been adopted and installed with some modifications in a number of two-year colleges. Outside the occupational training field, it has been applied in adult basic education programs and, with modification, in the design of basic literacy programs.

How It Is Developed

To construct the DACUM chart you must assemble a committee of resource persons expert in a given occupation.

Experience has found the best resource persons to be those skilled in the occupation (each nominated by an employer), many of whom have progressed to a supervisory role. In some instances there may be specialists in the occupation who are able to provide a more global view. Graduates of a program under curriculum revision are also involved in some DACUM workshops.

All of the chart development of the DACUM committee is done as a group. The committee is coordinated by a DACUM facilitator. The time required varies from one-and-a-half to four days, depending on the complexity of the occupation. Previously completed DACUM charts save time and effort. The DACUM Exchange at Humber College in Toronto, Canada keeps a current directory of developed charts by occupational heading.

The first major stage following committee orientation is defining the occupation's General Areas of Competence. This isn't difficult, since experts usually can easily identify them.

There are three kinds of General Areas of Competence:

(1) Those obvious divisions of skill in an occupation related to specific divisions in work assignments or to specific components of the object worked on in the occupation. (For example, in auto mechanics, General Areas of Competence are SERVICE & REPAIR FUEL SYSTEMS, SERVICE & REPAIR ELECTRICAL SYSTEMS, etc.);

(2) Those divisions of skills that can be identified as being extensively used as part of one or more of the types of activities identified in (1). (An example from auto mechanics might be USE REPAIR TOOLS & EQUIPMENT, or USE MEASURING & TESTING DEVICES, which are involved in each of the examples used in (1) above);

(3) Those divisions of skills which may become obvious later in development from an occupational or learning point of view. You may find that certain obvious divisions as in (1) can be grouped for convenience. (For example, SERVICE & REPAIR COOLING & EXHAUST SYSTEMS. On the other hand, certain extensive areas of competence may be found too unwieldly to handle and there may be obvious subdivisions, as SERVICE & REPAIR ENGINES AND REPAIR & OVERHAUL ENGINES.)

The second major task in developing a DACUM chart is to identify, isolate and define Individual Skills (behaviors) for each General Area of Competence.

These are destined to become learning units in the proposed training program. You should keep the descriptions of these skills task-oriented. Verbally each definition is prefaced by "the individual must be able to . . ."

On the chart omit this phrase, leaving a simple action definition, always introduced by a verb. This makes the definition of "concrete" skills such as OPERATE CHASSIS LUBRICANT EQUIPMENT quite easy. The definition of abstract or reasoning skills is more difficult but can be done. For example, DETECT & DIAGNOSE ENGINE FAULTS.

The committee should adopt the definition when it feels that most people with an adequate background in the occupation would understand what it means.

The facilitator judges the skill definition exercise complete when the committee has exhausted its collective knowledge of the needs of the occupation and has begun to repeat definitions or make trivial changes to those already accepted.

After agreeing on a set of General Areas of Competence and Individual Skill definitions, the committee should proceed to structure these skills into a desired learning sequence. The sequence should be from the point of view of an individual learning to acquire those skills in a work setting.

Assume that the trainee would begin at the left side of the chart and work on the right. Those skills most needed and most readily applied early in an actual work situation are on the left. Those skills that are little used or that the supervisor might wish to have left until the learner has developed some competence are on the right. (For example, REMOVE, INSPECT, REPAIR & INSTALL WHEELS, TIRES, TUBES & VALVES would precede TEST, ADJUST & REPLACE TORSION BARS).

Once the committee has sequenced each band, it brings the skills into a final structure by vertically aligning skills in different bands that would be first applied at approximately the same time.

The Rating Scale

The DACUM process focuses on the most readily available method of evaluation: observable behavior. Because most occupations do not have established standards, employers more often use observed behavior for evaluating employees. DACUM looks at the trainees in the same way that industry looks at employees.

Since the objective of occupational training is to provide employees who can satisfy industry's need for performance at work, it makes sense to focus evaluation directly on realistic work situations. You should avoid performance evaluation from the traditional point of view of the instructor. The instructor tends to evaluate in a simulated situation with artificial criteria.

The rating scale attached to each DACUM chart has resulted from much development. On the seven-point scale, the description of each level is designed to reflect a level of performance typically found or demanded in industry.

0— indicates unsatisfactory performance; includes the person who has attempted to learn and can't master the task, as well as the person who has had no chance to learn.

1— indicates a first level of successful performance; characteristic of a trainee who is able to perform the task, but normally can't achieve alone and needs much supervision.

2— indicates a person fairly capable of functioning independently and needs only periodic supervision.

3— indicates a person at minimum level of performance in each skill.

4— indicates a person whose performance in terms of speed and quality of work is better than would be expected at a minimal level.

5— indicates a person with excellent performance, who also has reached a level that enables him/her to solve unique problems in his/her work with initiative and adaptability.

6— indicates a person in the top level of employment in the occupation, who performs exceptionally well and has the ability to lead.

Benefits

The DACUM process does not require you to spend a lot of time and money preparing learning materials. Although there may not be many well-developed sources, such as textbooks, available for occupations with no training precedent, there is usually a wealth of information available from a variety of sources. If you can't locate materials for some skills, nonprofessional in-house materials are adequate to satisfy the needs of this kind of training program.

Because the emphasis is on individualized learning and self-programming by the trainee, the energy saved on program planning can be applied to providing the required resources. In summary, the DACUM process lends itself quite ideally to developing new training programs. Too often curriculum specialists and program planners devote too much energy to detailed planning and definition of a system they aren't even sure will work.

The DACUM quickly provides a more than acceptable level of definition and a system that lends itself to evaluating the effectiveness of procedures and materials as well as to rapid program change as soon as you detect a need.

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